SLOVENSKI STANDARD
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SIST EN 50317:2003
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Železniške naprave - Sistemi za odjem toka - Zahteve in veljavnost meritev medsebojnih dinamičnih vplivov med odjemnikom toka in kontaktnim vodnikom

Railway applications - Current collection systems - Requirements for and validation of measurements of the dynamic interaction between pantograph and overhead contact line

Bahnanwendungen - Stromabnahmesysteme - Anforderungen und Validierung von Messungen des dynamischen Zusammenwirkens zwischen Stromabnehmer und Oberleitung

Applications ferroviaires - Systèmes de captage de courant - Prescriptions et validation des mesures de l'interaction dynamique entre le pantographe et la caténaire

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English version

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

This document (EN 50317:2012) has been prepared by CLC/SC 9XC, "Electric supply and earthing systems for public transport equipment and ancillary apparatus (Fixed installations)", of CLC/TC 9X, "Electrical and electronic applications for railways".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2012-12-26
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2014-12-26

This document supersedes EN 50317:2002 + A1:2004 + A2:2007.

EN 50317:2012 includes the following significant technical changes with respect to EN 50317:2002 + A1:2004 + A2:2007:

- new definitions for “cord force”, “mean contact force” and “total mean uplift force” (Clause 3);
- updated abbreviation lists (Clause 4);
- requirements for examination of total mean uplift force and aerodynamic portions (new Clause 6);
- a clear relation between the different portions of contact force (7.1);
- limits for aerodynamic influences of the force measurement system (7.2);
- the aerodynamic correction for measured contact forces (7.4);
- corrections and elaborations for calibration of force measurement (7.5);
- adjustment of filter requirements (7.6);
- adjustment of accuracy requirements for measurement of displacements (Clause 8);
- updated requirements for measurement of arcing (Clause 9).

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This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) 2008/57/EC, see informative Annex ZZ, which is an integral part of this document.

1 Scope

This European Standard specifies the functional requirements for output and accuracy of measurements of the dynamic interaction between pantograph and overhead contact line.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50119 *Railway applications — Fixed installations — Electric traction overhead contact lines*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
collector head / pantograph head
pantograph equipment comprising the contact strips and their mountings

3.2
contact point
point of mechanical contact between a contact strip and a contact wire

3.3
working area of pantograph head
lateral and vertical range of possible contact points on the contact strips during normal operation

3.4
contact force
vertical force applied by the pantograph to the overhead contact line

Note 1 to entry: The contact force is the sum of the forces of all contact points

3.5
mean contact force F_m
statistical mean value of the contact force

Note 1 to entry: F_m is formed by the static and aerodynamic components of the pantograph contact force

3.6
static contact force
vertical force exerted upward by the collector head on the overhead contact line at standstill

3.7
standard deviation of contact force σ
square root of the sum of the square errors divided by the number of output values minus 1

3.8
aerodynamic force
additional vertical force applied by the pantograph as a result of air flow around the pantograph assembly. The aerodynamic force depends upon speed

3.9
statistical minimum of contact force
value of contact force represented by $F_m - 3\,\sigma$

3.10
statistical maximum of contact force
value of contact force represented by $F_m + 3\,\sigma$

3.11
cord force
measured force in a cord restraining a contact strip at a defined height

3.12
total mean uplift force
vertical force measured at the pantograph head, the latter not touching the contact line. It is equal to the sum of static contact force and the aerodynamic force caused by the air at the considered speed for a given height of contact points

3.13 transfer function magnitude
magnitude of the ratio between the applied and the measured forces of the pantograph and instrumentation determined by a dynamic excitation of the pantograph, at the pantograph head for a range of frequencies

3.14
tension length
length of overhead contact line between two terminating points
[SOURCE: EN 50119]

3.15
control section
representative part of the total measuring length, over which the measuring conditions are compliant with standard conditions

3.16
pantograph current
current that flows through the pantograph

3.17
arcs, arcing
flow of current through an air gap between a contact strip and a contact wire usually indicated by the emission of intense light

3.18
sensitivity curve
relationship between the power density of the arc in µW/cm² and the response of the detector in volts within the spectral range of interest

3.19
nominal current
current that flows through one pantograph for nominal power of train

3.20
percentage of arcing *NQ*
proportion of driving time with arcing

4 Abbreviations and symbols

For the purposes of this document, the following abbreviations and symbols apply.

$a_{Sensori}$ acceleration measured in acceleration sensor i

d	measurement distance between arc detector and light source (contact strip)
d_{ref}	reference distance between arc detector and light source
$F_{applied}$	force applied to pantograph head
F_c	contact force
$F_{corraero}$	aerodynamic force correction (see 7.4)
F_m	mean contact force
$F_{measured}$	force measured
$F_{Sensori}$	measured force in sensor i
f_1	minimum frequency
f_i	actual frequency
f_n	maximum frequency
g	surface power density generated by the smallest arc that shall be detected at reference distance
J	accuracy of the transfer function
k_a	number of acceleration sensors
k_f	number of force sensors
m_{above}	mass between contact point and force sensors (see 7.3)
NQ	percentage of arcing
n	number of frequency steps
t_{arc}	duration of arcs recorded
t_{total}	measured duration with a pantograph current greater than a specified value
x	surface power density generated by the smallest arc that shall be detected at measurement distance
x_{ref}	surface power density generated by the smallest arc that shall be detected at reference distance
σ	standard deviation of contact force

5 General

The measurement of the interaction of the contact line and the pantograph is intended to prove the safety of operation and the quality of the current collection system. Results of measurements of different current collection systems shall be comparable, to approve components for free access within Europe.

NOTE Measured values are also required for validation of simulation programs and other measurement systems.

To check the performance capability of the current collection system at least the following data shall be measured:

– the contact wire uplift at the support as the pantograph passes;

and either

– the mean contact force and standard deviation

or

– the percentage of arcing.

In addition to the measured values, the operating conditions (train speed, location...) shall be recorded continuously and the environmental conditions (rain, ice, temperature, wind, tunnel...) and test configuration (parameters and arrangement of pantographs, type of overhead contact system...) during the measurement shall be recorded in the test report. This additional information shall ensure repeatability of the measurement and comparability of the results.

6 Measurement of total mean uplift force

Where a tethered test is used to measure the total mean uplift force the following requirements shall be fulfilled.

A tethered test determines cord force(s). The total mean uplift force is the sum of all mean values of the measured cord forces at the chosen height, speed and measurement conditions.

The aerodynamic force is the total mean uplift force minus the static contact force.

For this measurement the pantograph shall be restrained at a height as near as possible to the contact wire height for which the result shall be valid. The restraint shall be provided by vertical cords to each collector strip. The cords shall have adequate tensile stiffness, to constrain pitching of the head.

The accuracy of adjustment shall be checked on horizontal track without cant. The collector strips shall be adjusted so that the along track and cross track errors are less than 1,5° relative to plane of rails.

The contact wire shall not touch the pantograph during the test.

NOTE 1 A typical distance between collector head and contact wire is 10 cm to 15 cm.

The force in each cord shall be measured.

The dynamic behaviour of the cord forces depends on a number of influences (surrounding conditions, turbulence around the cords, track conditions, tunnels...).

To achieve confidence with the results the variance of the forces recorded and their repeatability over different sections shall be demonstrated.

The speed dependency shall be measured between 80 km/h and the maximum speed in steps. The step shall be chosen in accordance with the maximum train speed.

NOTE 2 A typical step is 20 km/h or 5 steps for the complete speed range.

In addition to the conditions recorded according to Clause 5, the train configuration and driving direction and also the restrained height and wear conditions of the collector strips shall be noted.

As a result of the tethered test the total mean uplift force as a function of speed for the measured configuration shall be presented.